Magnetic Effects of Electric Current

Periodic Test

Q.1. What is the function of an earth wire in electrical instruments?

Answer: Earth wire is used as a safety precaution because whenever there is short circuit and if we touch that appliance, we will get shock, so in spite of letting the current pass from our body, we make it pass to earth. Earth wire is in green/blue color. It prevents overloading of live wire.

Q.2. List any two uses of an electromagnet.

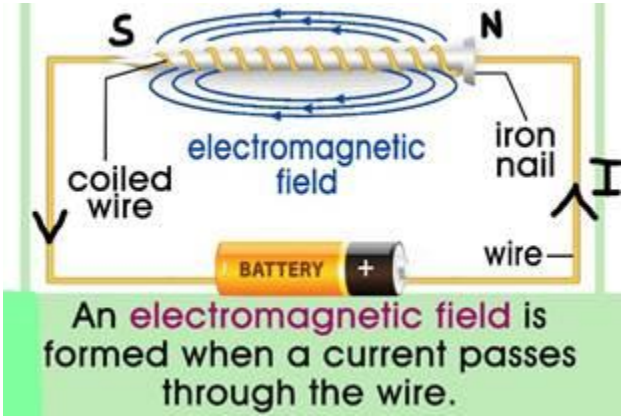
Answer: Uses of electromagnet are: –

I. It is used in motors and generators to change the magnetic flux linked with the coil and produce current.

II. It is used in transformers to alter the voltage by the phenomena of mutual induction.

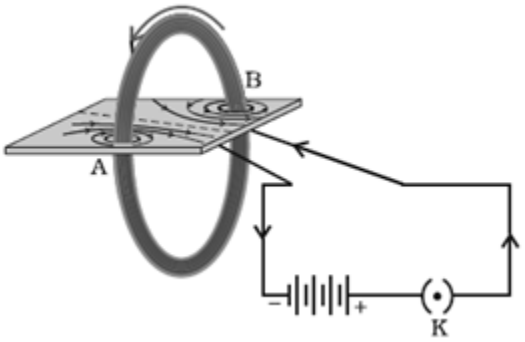
Q.3. Draw a labelled diagram to show how an electromagnet is made.

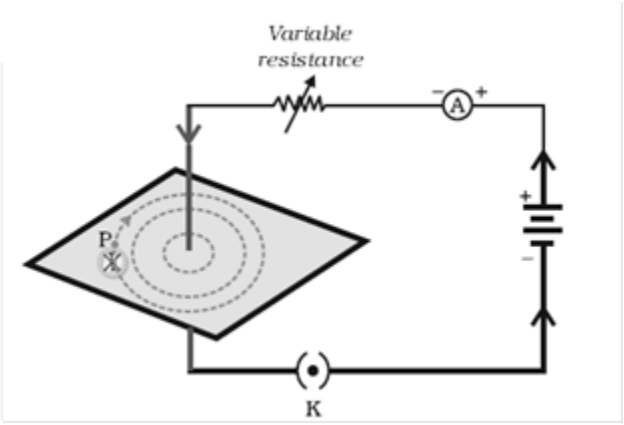
Answer: We use an iron nail, battery, copper wire to make the circuit.



Q.4. Describe an activity to demonstrate the direction of the magnetic field generated around a current carrying conductor.

Answer: Different shapes of conductors have different type of magnetic field.





• Take a straight thick copper wire and place it between the points X and Y in an electric circuit. The wire XY is kept perpendicular to the plane of the paper.

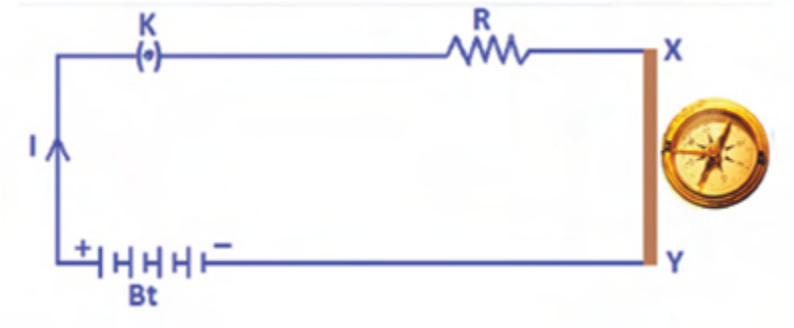
• Horizontally place a small compass near this copper wire. See the position of its needle.

• Pass the current through the circuit by inserting the key into the plug.

• Observe the change in the position of the compass needle and the direction of deflection.

• Interchange the battery connection in the circuit so that the direction of the current in the copper wire changes.

• Observe the change in the direction of deflection of the needle.



Q.5. Name one material used for making permanent magnets. Describe how permanent magnets are made electrically.

Answer: Iron is the material used for making electromagnets because of its magnetic properties which makes it magnetize easily and makes it able to be magnetized for longer time.

An electromagnet is made by rounding a wire and make its shape as same as solenoid which acts as a bar magnet when electric current is passed through it. If we insert soft iron core in it, its magnetic field would increase.

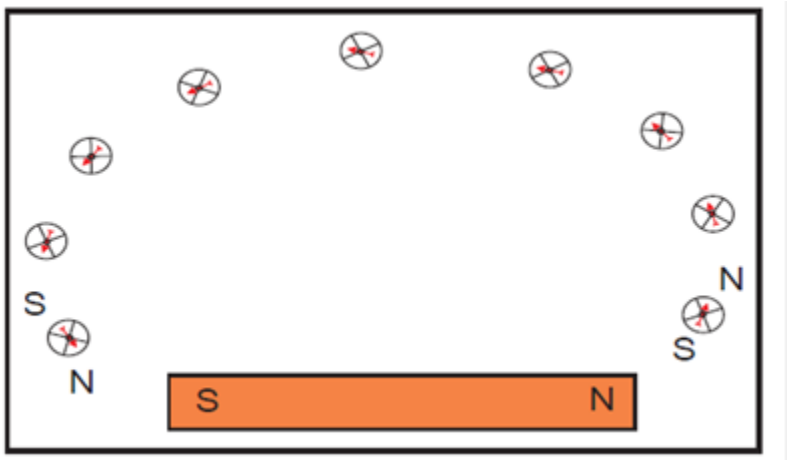
Q.6. Describe an activity to draw a magnetic field line outside a bar magnet from one pole to another pole.

Answer:

- Take a small compass and a bar magnet.
- Place the magnet on a sheet of white paper fixed on a drawing board, using some adhesive material.
- Mark the boundary of the magnet.
- The south pole of the needle points towards the north pole of the magnet.

The north pole of the compass is directed away from the north pole of the magnet.

- Mark the position of two ends of the needle.
- Now move the needle to a new position such that its south pole occupies the position previously occupied by its north pole.
- In this way, proceed step by step until you reach the south pole of the magnet.
- Join the points marked on the paper by a smooth curve. This curve represents a field line.
- These lines represent the magnetic field around the magnet. These are known as magnetic field lines.
- Observe the deflection of the compass needle as you move it along the field line. The deflection increases as the needle is moved towards the pole.



Q. 7. (a) What is the function of an earth wire in electrical instruments? Why is it necessary to earth the metallic electric appliances?

(b) Explain what is short-circuiting and overloading in an electric supply.

(c) What is the usual capacity of the fuse wire in the line to feed:

(i) Lights and fans?

(ii) Appliances of 2 kW or more power?

Answer: (a) The main function of earth wire is to absorb excess electricity passing through the appliance and to prevent overloading of live wire. The metallic appliances are earthed because whenever there is leakage of current, the leaked current passes through the earth wire to earth.

(b) Short Circuit – When live wire comes in contact with Neutral wire then the resistance becomes zero and with Ohm's law current becomes infinite.

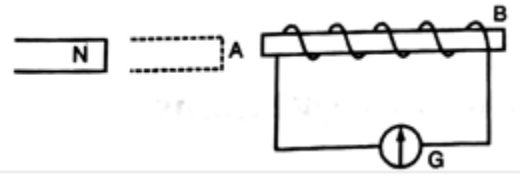
Overloading – When a large number of home appliances are connected simultaneously to same socket and they withdraw large amount of current than mentioned on the switch.

(c) Fuse wire is a safety measurement used in case of overloading, short-circuiting or high voltage from the electricity board.

i. The usual capacity of the fuse wire in the line to feed lights and fans is around 15-20 A or less.

ii. The usual capacity of the fuse wire in the line to feed appliances of 2 kW or more power is a minimum of 30 A but it is preferred to have 50-60 A or less.

Q.8. The diagram below shows a coil connected to a Centre zero galvanometer G. The galvanometer shows a deflection to the right when the N-pole of a powerful magnet is moved to the right as shown.



(i) Explain why the deflection occurs in the galvanometer.

(ii) Does the direction of current in the coil appear clockwise or anticlockwise when viewed from end A?

(iii) State the observation in G when the coil is moved away from N.

(iv) State the observation in G when, both coil and the magnet, are moved to the right at the same speed.

Answer: i. The deflection in the galvanometer occurs because of change in magnetic flux linked with the coil which results in formation of induced emf and further induced current due to the phenomena called electromagnetic induction.

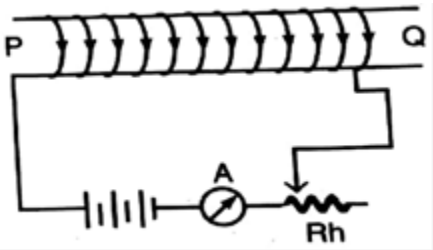
ii. The direction of current appears to be anti-clockwise from point A because at point A there is formation of North pole and at point B there is formation of South pole.

iii. When the coil is moved away from north pole the direction of induced current gets reversed because point A now becomes South pole and point B now becomes North pole due to change in magnetic flux linked with the coil. So, the galvanometer will show deflection to the left side.

iv. There would be no observation change in galvanometer as the magnet and closed coil are moving with same speed and have no relative motion. For formation of induced emf, there must be relative motion between magnet and coil.

Q.9. The figure shows a long solenoid, a cylindrical coil of a number of turns of insulated copper wire, connected to a battery through an ammeter A and a rheostat Rh.

(i) Which end of the solenoid is an N-pole and which end is an S-pole?

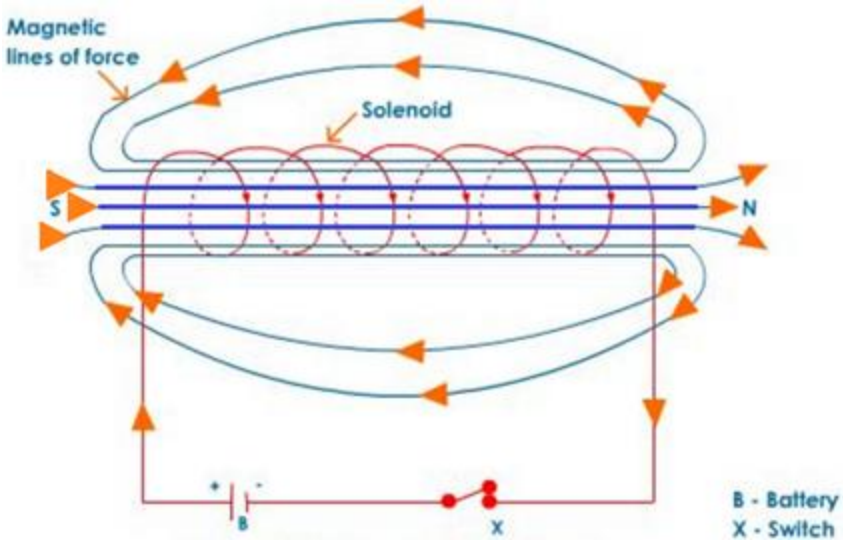


(ii) Draw the magnetic field lines inside the solenoid and indicate their directions. Are magnetic field lines closed?

(iii) How can you increase the strength of the magnetic field inside the solenoid? Give two methods.

Answer: i. Point P is the South pole and point Q is the North pole because of the specified direction of the current flowing in the solenoid and by using right-hand thumb rule our thumb points towards point Q, so it is North pole.

ii. Yes, magnetic field lines form closed loops and inside the solenoid they go from south to north pole and outside the solenoid it goes from north to south pole.



iii. By looking at the formula for magnetic field of solenoid we can say the two methods for increasing magnetic field are: –

$B = \mu_o n I$

(a) By increasing the number of turns per unit length.

(b) By increasing the amount of current passing through it.

Q.10. (a) What is meant by a magnetic field?

(b) How is the direction of magnetic field at a point determined?

(c) Describe an activity to demonstrate the direction of the magnetic field generated around a current carrying conductor.

(d) What is the direction of magnetic field at the Centre of a current carrying circular loop?

Answer: (a) Magnetic field is the area in which the magnetic strength of a magnet can be felt by a magnetic material, inside this field the magnet can either attract or repel the magnetic substances.

(b) We can determine magnetic field direction by using magnetic compass by placing it at that point and observing the needle's direction.

(c) • Take a straight thick copper wire and place it between the points X and Y in an electric circuit. The wire XY is kept perpendicular to the plane of the paper.

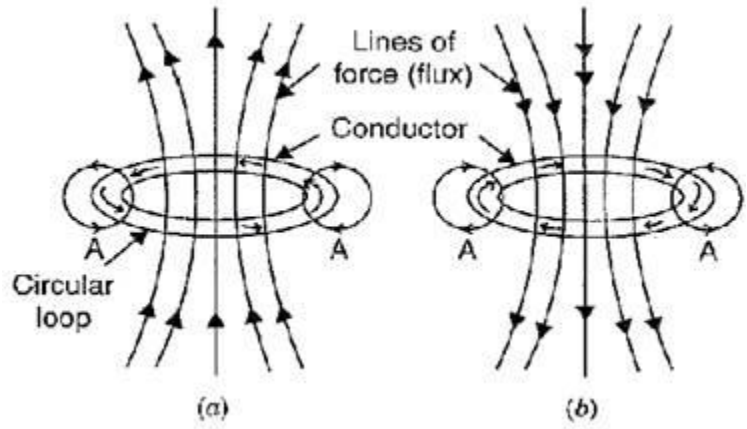
• Horizontally place a small compass near this copper wire. See the position of its needle.

- Pass the current through the circuit by inserting the key into the plug.
- Observe the change in the position of the compass needle and the

direction of deflection.

- Interchange the battery connection in the circuit so that the direction of the current in the copper wire changes.
- Observe the change in the direction of deflection of the needle.

(d) The direction of magnetic field depends upon the direction of current passing through that circular loop. If the current is flowing clockwise then the direction of magnetic field is inside the loop along the axis and vice versa.



Comprehensive Exercises (MCQ)

Q.1. A current carrying wire produces:

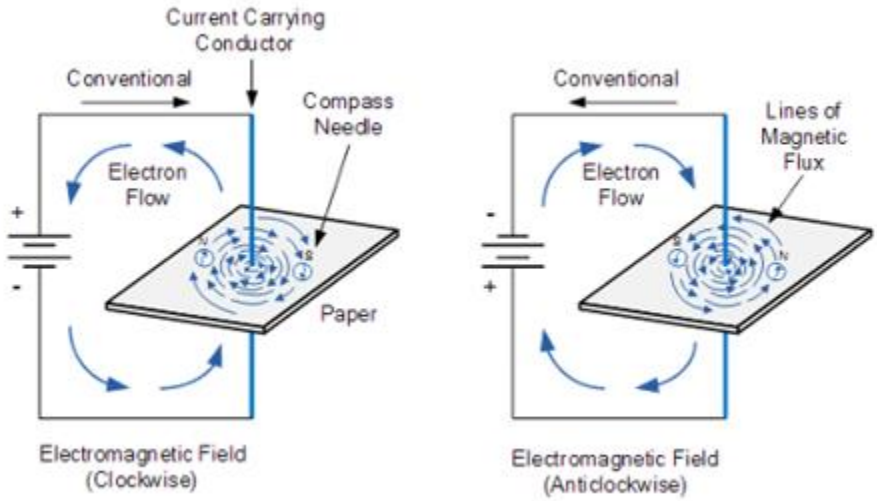
A. an electric field

B. a magnetic field

C. both electric and magnetic fields

D. neither electric nor magnetic field

Answer: Whenever current is passed through a conductor it develops magnetic field around it, in case of wire the magnetic field is circular around it and is given by right-hand thumb rule.



Q.2. By increasing the number of turns 3 times in a toroidal solenoid, the magnetic field:

A. will become three times

B. will remain unchanged

C. will reduce to one-third

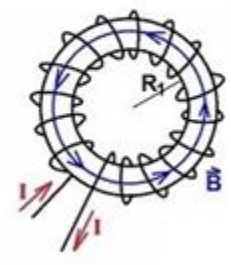
D. none of these

Answer: This is a rule you need to memorize that the magnetic field of all the instruments used is directly proportional to the number of turns with same powers.

That is, B – magnetic field; N – number of turns.

$B \propto N$

The Toroidal Solenoid: Non-Uniform Magnetic field



$$B = \frac{\mu_0 N I}{2\pi (R_1 + a)}$$

Q.3. The induced potential difference produced, in a coil when a magnet is inserted in it doesn't depend upon:

A. number of turns of the coil

B. the resistance of the coil

C. the magnetic moment of the magnet

D. the speed of approach of the magnet

Answer: The induced potential difference depends upon the number of turns and the rate of change of magnetic flux with time. The induced current depends upon the resistance of the coil.

Q.4. The laws of electromagnetism tell us that energy can be transferred from one object to another:

A. even if there is no material medium

B. instantaneously

C. only if they are connected by a cable

D. only in pulses but not continuously

Answer: The transfer of energy is in the form of radiation and radiation is in the form of electromagnetic rays and these rays do not need any material medium to propagate.

Q.5. A soft iron bar is introduced inside a current carrying solenoid. The magnetic field inside the solenoid:

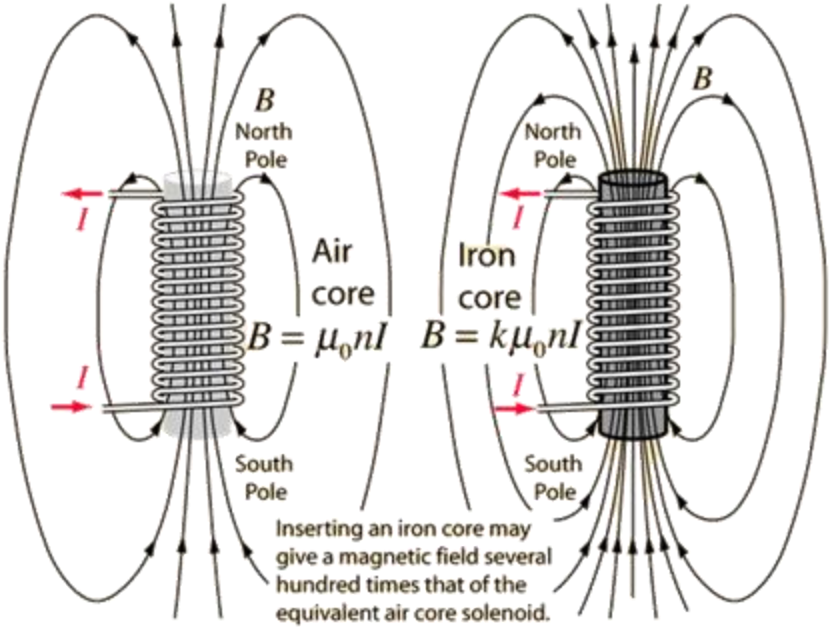
A. no change

B. will decrease

C. will increase

D. uncertain

Answer: Iron can be magnetized easily and hence when it is introduced in the solenoid it gives its own magnetic field like solenoid and it is just like a wire passing through the solenoid through which current passes and it develops magnetic field around it.



Q.6. Inside a current carrying solenoid the magnetic lines of force are:

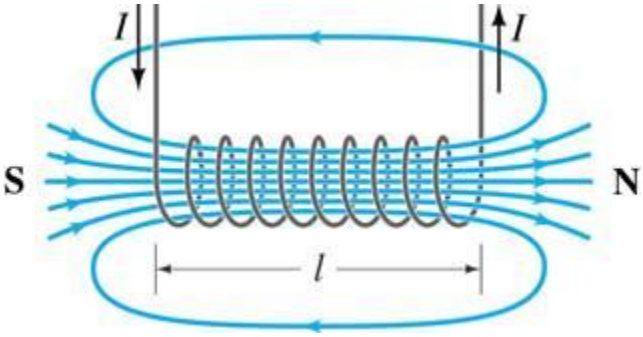
A. circular and do not intersect.

B. along the axis of the solenoid and parallel to each other.

C. perpendicular to the axis of the solenoid.

D. none of these

Answer: An ideal solenoid acts like a wire but it is round in shape and if we look at its each turn one at a time, we will get the direction of magnetic field using right-hand thumb rule. Each circle has magnetic field passing along its axis when we look inside it.



Q.7. The material of the core of a strong electromagnet is:

A. steel

B. soft iron

C. wrought iron

D. brass

Answer: As we know that soft iron gets magnetized easily and it can retain its magnetization for a longer time, that is why it is used in electromagnets.

Q.8. The direction of induced potential difference is given by:

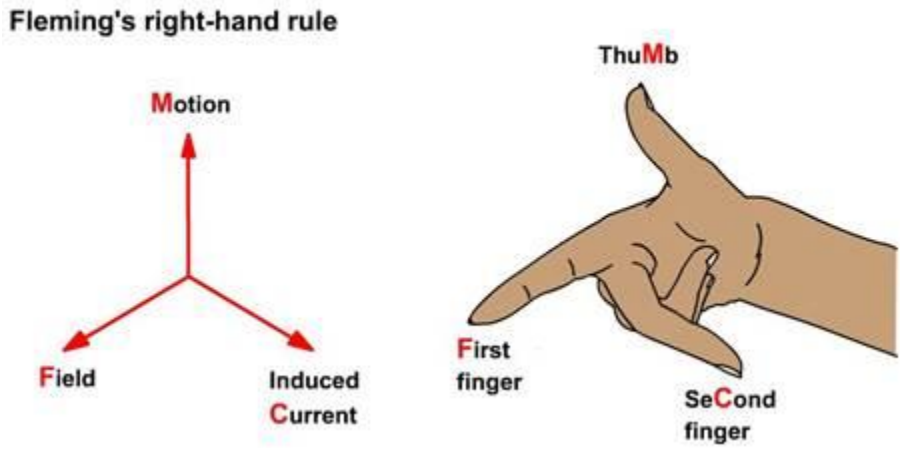
A. Cork screw rule

B. Right hand thumb rule

C. Fleming's left-hand rule

D. Fleming's right hand rule

Answer: Fleming's right hand rule is used in generators where the direction of induced current is found and Fleming's left-hand rule is used to find the direction of force acting on a current carrying conductor in a magnetic field.



Q.9. The principle of which of these devices is electromagnetism:

A. galvanometer

B. motor

C. transformer

D. all of these

Answer: In transformers, the current is passed from one coil(solenoid) to another solenoid through the phenomena of electromagnetic induction or more precisely called mutual induction.

From one current carrying coil, the other induces emf due to change in magnetic flux linked with it.

Q.10. The agnetic field around a current carrying conductor is:

A. directly proportional to r

B. inversely proportional to r

C. directly proportional to r^2

D. inversely proportional to r^2

Answer: The general formula of magnetic field consists of the circumference of the body through which the magnetic field is passing in the denominator and in the numerator, it consists of current passing through the body and a proportionality constant.

$B(2\pi R) = \mu o^I$

Q.11. The strength of the magnetic field of a solenoid does not depend upon:

A. current through it

B. number of turns of the coil

C. core of the coil

D. area of the coil

Answer: The magnetic field of solenoid is directly proportional to the current passing and the number of turns and has a proportionality constant which depends on material of conductor, instead of area magnetic field depends upon the length of solenoid.

Q.12. The phenomenon of electromagnetic induction is:

A. the process of charging a body

B. the process of generating a magnetic field due to current passing through a coil.

C. producing induced current in a coil by relative motion between a magnet and a coil.

D. the process of rotating a coil of an electric motor.

Answer: When there is relative motion between a magnet and a closed loop there is formation of induced emf due to change in magnetic flux linked with the coil. More the speed more the induced emf.

Q.13. A device used for producing current is:

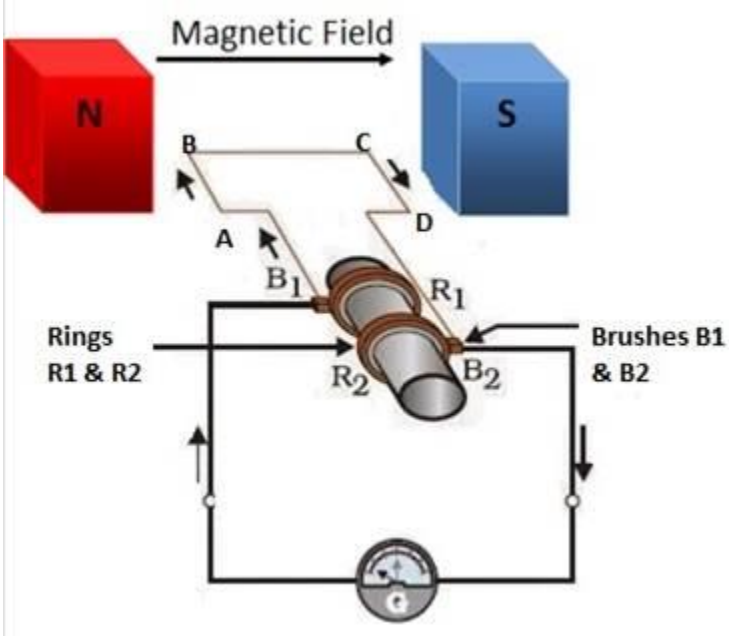
A. generator

B. voltmeter

C. ammeter

D. galvanometer

Answer: Generator uses the principle of electromagnetic induction to produce induce emf which further produces induced current. The generator has a rotating coil between two magnet poles.



Comprehensive Exercises (T/F)

Q.1. Write true or false for the following statements:

If the direction of current is reversed, the direction of magnetic field is also reversed.

Answer: True.

By right hand thumb rule, we can determine the direction of current with respect to magnetic field and vice versa, and we have found that direction of current becomes opposite along with the direction of magnetic field.

Q.2. Write true or false for the following statements:

To find the direction of magnetic field around a current carrying conductor, we use Fleming's left-hand rule.

Answer: False.

To find the direction of magnetic field around a current carrying conductor we use Right hand thumb rule, and we use Fleming's left-hand rule to find the direction of force on current carrying conductor in magnetic field.

Q.3. Write true or false for the following statements:

Magnetic field due to a straight current-carrying conductor is in the form of concentric circles.

Answer: True.

The pattern of magnetic field is like concentric circles around straight conductor according to right hand thumb rule or cork screw rule.

Q.4. Write true or false for the following statements:

A current carrying solenoid behaves like a bar magnet.

Answer: True.

The pattern of magnetic field is same in current carrying solenoid and bar magnet and with same magnetic poles.

Q.5. Write true or false for the following statements:

Inside a solenoid, the magnetic field is constant in magnitude and direction.

Answer: True.

Inside the solenoid, the magnetic field lines are equally spaced and parallel and are inside circular curves of solenoid which provide uniformity.

Q.6. Write true or false for the following statements:

Magnetic field produced by a current carrying solenoid depends directly upon the strength of the current.

Answer: True.

The formula for the magnetic field of solenoid and most of the electric appliances is directly proportional to current passing through it.

$B \propto I$

Q.7. Write true or false for the following statements:

In order to find the force experienced by a current carrying conductor, we can use Maxwell's cork screw rule.

Answer: False.

Maxwell's corkscrew rule or right-hand thumb rule is used to find the direction of magnetic field when we are given with the direction of current and vice versa. In order to find force on a current carrying conductor we use Fleming's left-hand rule.

Q.8. Write true or false for the following statements:

Whenever magnetic field through a coil is changed, a potential difference is produced in the coil.

Answer: True.

The phenomena of electromagnetic induction produce induced emf whenever there is change in magnetic flux linked with a closed coil.

Q.9. Write true or false for the following statements:

The strength of the induced potential difference depends on the relative speed between the coil and the magnet.

Answer: True.

The relative speed between the magnet and the closed loop is one of the factors on which the magnitude of induced emf produced depends.

Q.10. Write true or false for the following statements:

Electric motor converts mechanical energy into electrical energy.

Answer: False.

Electric motor is a device which is used to convert electrical energy into mechanical energy. Generator is a device used to convert mechanical energy to electrical energy.

Q.11. Write true or false for the following statements:

Fleming's right hand rule can be used to find the direction of magnetic field.

Answer: False.

Fleming's right hand rule is used in generators to find the direction of induced current. To find the direction of current we use right hand thumb rule.

Q.12. Write true or false for the following statements:

Electric generator works on the principle of electromagnetic induction.

Answer: True.

The coil which is rotated between two magnets cuts the magnetic field due to which there is a change in magnetic flux linked with the coil and hence phenomena of electromagnetic induction take place.

Q.13. Write true or false for the following statements:

The electric current that always flows in the same direction is called alternating current.

Answer: False.

The electric current which always flows in the same direction is called Direct current, and the electric current which changes its polarity after same intervals of time is called alternating current.

Q.14. Write true or false for the following statements:

Normally red colour cable is used for live wire.

Answer: True.

Red colour wires are used for live wire; Black colour wires are used for neutral, and green/blue are used for earth wire.

Q.15. Write true or false for the following statements:

All the distribution circuits for domestic purpose are parallel connections.

Answer: True.

We want to switch on and off different appliances at different time and we want to give each appliance the same potential difference and we do not want our other appliances not to work if one gets broken or damaged.

Q.16. Write true or false for the following statements:

One should always use rubber gloves and rubber shoes when dealing with electricity.

Answer: True.

Rubber is a good insulator of electricity and if we wear rubber gloves and shoes current is not able to pass through our body and we do not feel shock. It is a safety precaution against electricity.

Q.17. Write true or false for the following statements:

Earthing of electrical appliances is very important.

Answer: True.

Earthing of electrical appliances is a safety measure taken in case of happenings of short circuits because short circuit can make current flow through us when in contact, so earthing gives current a direction to flow to earth rather than to humans.

Q.18. Write true or false for the following statements:

Like magnetic poles attract each other; unlike poles repel.

Answer: False.

Unlike magnetic poles attract each (North and South attract) other and like magnetic poles repel each (North repel North and South repel South) other.

Q.19. Write true or false for the following statements:

If you strike a sharp edge of a metallic knife against the north pole of a bar magnet, it will induce a north pole.

Answer: False.

If we magnetize something from one side touching to a magnet from North pole, there is always generation of opposite pole on the touching side which is South pole and on the non-touching side there will be North pole again.

Q.20. Write true or false for the following statements:

The magnetic field produced by a current in a straight wire has no poles.

Answer: True.

If we put a current carrying wire in a magnetic field perpendicular to its length, then it neither gets attracted or repelled by that field and hence these concentric circles neither have a starting point nor an ending point and the compass points tangential to the circles at every point.

Q.21. Write true or false for the following statements:

An electric generator is a device that converts electrical energy into mechanical energy.

Answer: False.

An electric generator is a device used to convert mechanical energy, which is used to rotate the coil between magnets, into electrical energy which is obtained by the phenomena called electromagnetic induction.